MODULAR REFRIGERATION AND/OR FREEZER APPLIANCE

The present invention relates to a modular refrigeration and/or freezer appliance in accordance with the introduction to the main claim. In particular, it relates to the structure of a refrigeration and/or freezer appliance or the like, and to its components, which are such as to render the structure sectional and adaptable to the most varied requirements.

As known to the expert of the art, known refrigeration appliance structures are formed from a plurality of panels and profile bars joined together by screw means or by injected insulating material (foam) made to expand between said panels and profile bars; the same insulating material maintains the panels and profile bars joined together. This involves considerable assembly times and high costs in terms of the labour required to handle a large number of pieces and to properly assemble them.

A first problem derives from the fact that the means for coupling the various module components together are such that once the refrigeration or freezer appliance has been assembled, it cannot be easily disassembled.

In addition, alignment between the various module components, for example in the case of assembly by means of foam, is particularly critical and must be delegated to expert qualified, and hence costly, personnel possibly using templates or support jigs.

Moreover the structure of such refrigerators, being based on a number of structural parts joined together to form a frame, does not present good structural rigidity as the connections between the various panels are

delegated merely to the injected insulating material.

In addition, the joining together of various structural parts typically results in a worsening of the thermal insulation of the cabinet, as the connections between the various panels introduce material continuity between the external environment and the interior of the refrigerated compartment, resulting in poorer insulation characteristics than commonly used expanded materials, hence giving rise to thermal bridges which increase heat transfer between the external environment and the thermally insulated compartment.

DE 1911903 describes a horizontal modular refrigerator cabinet consisting of a plurality of U-shaped structural modules of rigid foamed material disposed horizontally side by side such that the side walls of each U-shaped module define the upper and lower walls of the refrigerator cabinet. The refrigeration compartment is closed frontally by doors and laterally by flat panels of the same material with which the modules are made. The said patent does not provide details of how such flat panels are fixed to the ends of the U-shaped modules, which are abuttingly joined to each other. Moreover, such a type of cabinet is suitable more for commercial use (bars, beer houses, etc.) than for domestic use, as the U-shaped elements define a sort of refrigerated counter.

An object of the present invention is to provide a modular refrigeration and/or freezer appliance which is improved compared with the known art, in the sense that it enables high structural rigidity to be achieved with easy assembly by reversible means providing perfect sealing of thermal insulation.

A further object of the present invention is to provide a modular refrigeration and/or freezer appliance for domestic use which can be easily assembled, even by not particularly expert personnel and without the use of templates and similar equipment, so minimizing assembly time and cost, facilitated by consisting of just a small number of parts.

A further object of the present invention is to provide a refrigeration and/or freezer appliance in which the presence of thermal bridges which worsen thermal insulation characteristics is minimized.

These and other objects are attained by a modular refrigeration and/or freezer appliance according to the technical teachings of the accompanying claims.

Further characteristics and advantages of the invention will be apparent from the description of a preferred but non-exclusive embodiment of the modular refrigeration and/or freezer appliance, illustrated by way of non-limiting example in the accompanying drawings, in which:

Figure 1 is a schematic exploded view of a modular refrigerator of the present invention;

Figures 2 and 3 are perspective views of details of the refrigerator of Figure 1;

Figures 2A and 3A are enlarged perspective views of details of Figures 2 and 3 respectively;

Figure 4 and Figure 5 are perspective views of details of the refrigerator of Figure 1 assembled;

Figures 6, 7A, 7B are enlarged views of a detail of Figure 1;

Figures 8 and 9 are rear perspective views of a refrigerator of the invention, showing a conduit-like element in a pre-assembly configuration

and respectively in an assembled configuration mounted on the rear wall of the refrigerator;

Figure 10 is a perspective view of a first variant of a detail of the assembled modular refrigerator;

Figure 11 is a section on the line XI-XI of Figure 10;

Figure 12 is a perspective view of a further variant of the assembled modular refrigerator of the invention;

Figure 13 is a section on the line XIII-XIII of Figure 12;

Figure 14 is a perspective view of a further variant of the modular refrigerator of the invention, in which the thermal bridges are further reduced;

Figure 15 is a schematic view of a different embodiment of the refrigeration appliance of the present invention;

Figure 16 is a perspective view of an air duct to be used in the refrigerator according to the invention; and

Figure 17 is a perspective view of two elements of the refrigerator according to the invention, in which the air duct of figure 16 is used.

Said figures show a modular refrigeration and/or freezer appliance indicated overall by 1. It comprises a base module 2 for containing the components necessary to obtain the refrigeration effect within the appliance, and in particular a compressor, a condenser and a cooling fan with respective drive motor. These components are of conventional type and will therefore not be further described.

The base module 2 presents a lower plate 3 from which a pair of lateral walls 4a, 4b branch, on the flat top 5a, 5b of which means 6a are provided for its connection to other corresponding modules, which will be described

hereinafter. Said connection means in Figure 1 consist of guides 6a of inverted double L shape. The particular shape of these guides gives them slight elasticity, which is very useful for improving the seal when coupled to a corresponding counter-guide 6b. These counter-guides 6b are facingly present on both the lower and upper sides of the branches 7a, 7b of a first reversible U-shaped profile bar 7. The counter-guides 6b and their arrangement are well visible in Figure 2A; they are substantially T-shaped, the guides 6a sliding within them with slight interference. The connection is particularly stable in that it utilizes the said elasticity of the inverted L-shaped profile bar of the guides 6a, the connection being perfectly sealed.

The U-shaped profile bar 7, of cross-section symmetrical about the axis "a" of Figure 2A, presents further guide slots 8. The guide slots 8, also double given the symmetry of the U-shaped profile bar, are formed of first outer flanges 8a, exceeding second inner flanges 8b in length. The slots act as a seat for two panels 9, which will be described in detail hereinafter.

As is evident in Figure 1, the first U-shaped profile bar 7 is mounted from the front onto the base module 2 by sliding the guides 6a of the base module 2 within the counter-guides 6b of the bottom of the U-shaped profile bar 7. Identical panels 9 are slid within the upper and lower guide slots 8, before mounting the U-shaped profile bar 7 on the base module 2. The panels 9 are hence well secured and, together with the inner walls of the U-shaped profile bar 7 and the wall 11 of a second U-shaped profile bar 10 (described hereinafter), form a compartment which when injected with insulating material, for example foamed polyurethane, forms the

bottom panel 41 of the refrigeration appliance compartment.

The second U-shaped profile bar 10, shown in its entirety in Figure 3 (and in detail in Figure 3A), presents, on the upper surface of two lateral branches 10a, b, guides which are totally similar to those presented by the base module 2 and already described. On the third branch 10c, which joins the lateral branches together, there is a wall 11 of height at least equal to the height of the U-shaped profile bar 7. The second U-shaped profile bar 10 also laterally presents further seats 12 for a front plate 13 and a rear plate 14 inserted head-on into said seats 12.

In the illustrated example, the front plate 13 is a bent enamelled metal sheet, presenting a rear part 13a, two side parts 13b disposed as the sides of a U, and two front parts 13c bent at a right angle to the side parts 13b. This front plate 13 will form the interior of the refrigeration appliance compartment.

The rear plate 14 presents only a rear part 14a and two side parts 14b, which also form a U cross-section. This rear plate will form the rear and side exterior of the appliance.

In assembly, the front plate 13 and rear plate 14 are positioned face to face and inserted head-on into the seats 12 of two second U-shaped profile bars 10, one disposed upperly and one lowerly. Between the profile bars and plates there is thus created a U-shaped compartment which when filled with foamed insulating material 15 consolidates the structure. The combination forms an insulated U-shaped module 16 which is structurally very rigid.

The U-shaped module 16 is then joined to the base module 2, specifically to the first U-shaped profile bar 7 already mounted on the base module 2

and fixed to it by means of the guides 6a.

The top 40 of the refrigeration appliance is formed by again using a first U-shaped profile bar 7, identical to that already described, in which a panel 9 is lowerly inserted and an upper panel 18 is upperly inserted carrying lower guides 6a for engagement with the U-shaped profile bar 7. Figure 4 shows this connection in detail, and highlights the compartment 19 which is to be filled with insulating material. In this latter, and specifically in the panel 9 or flat module, one or more holes 20 can be provided to allow passage of electric cables or conduits for refrigerant fluid via suitably provided channels 21.

A refrigerator has so far been described formed from a single U-shaped module 16 mounted on a base 2 (via an interposed bottom panel 41) and closed upperly by a top 40, as shown in Figure 1, however the modular refrigerator of the invention can be formed from several superposed U-shaped modules 16 joined together at flat joining and stiffening panels similar to the bottom panel 41, i.e. provided with the same counter-guides 6b described with reference to the bottom panel 41 and to the top 40. In this manner, each U-shaped module 16 can be rapidly mounted on the underlying module by using the flat joining and stiffening panels.

In the base module 2 a seat 22 is provided in each side wall 4a, 4b for housing a hinge module 23. The hinge module 23 lowerly presents a dovetail profile 23a to slidingly engage a corresponding profile 22a of the seat 22. The hinge module is locked in the seat 22 by an elastic tang (not visible) acting on its base.

The hinge module, which can be mounted on the right or left depending on the direction of opening of the door 27, presents a pin 24 housed in

holes 25' or 25". The pin is housed in the holes 25' or 25" depending on the direction of opening of the refrigeration appliance door 27. The pin 24 is fixed by bayonet insertion using a lever 26 removably applicable to the pin 24.

When in use, the refrigerator door 27 is hence hinged lowerly about the pin 24 and upperly by conventional inserts fixed for example to the upper U-shaped profile bar 7.

In a different embodiment shown in Figures 7A, B, only a single hole is provided to house the pin 24. The lever 26 for manipulating the pin 24 can be seen in these figures.

By joining together the aforedescribed components, an adaptable modular refrigerator is formed, the described components giving it the maximum degree of flexibility.

A different embodiment is shown in Figures 8 and 9 in which a channel 124 is connected vertically to the rear of the U-shaped module 16, and to the bottom and top panels 41 and 40 respectively. Cables 125 and/or pipes 126 pass through the channel 124. The method of connecting the channel 124 to the refrigerator cabinet is not shown in the drawings, but can be by traditional fixing systems (snap-insertion, gluing, welding).

In the variant shown in Figures 10 and 11 the top panel 40 (or an intermediate flat element in the case of several superposed U-shaped modules) is provided with an internal conduit 21 to connect the rear wall of the cabinet, provided with the channel 124, to the cell interior. In this configuration the channel 124 acts to convey refrigerated air from the base module 2 to the cell and vice versa. Again in this configuration, the channel can instead act as a simple passage for the circuit pipes and

electric cables. In a similar manner, in the variant shown in Figures 12 and 13, preinstalled cables 122 and/or pipes 123 are run inside channels 121 provided in the top panel 40 (or in an intermediate flat element in the case of several superposed modules) and can then be connected to the rest of the electrical/electronic circuit, and in particular to the cables and pipes (125, 126) mounted in the channel 124 using suitable connectors (not shown).

In a different embodiment of the modular refrigeration appliance, shown in Figure 14, the bars 7, 10 on which the guides and counter-guides 6a and 6b are provided present suitable discontinuities 101 in their constituent materials. By interrupting the continuity of these materials the thermal bridges between the external environment and the thermally insulated compartments are minimized.

In a different embodiment of the modular refrigeration appliance, shown in Figure 15, the connection means consisting of guides 6a and counter-guides 6b can be replaced by couplings 30 snap-cooperating with suitable seats 31 provided in the first and second U-shaped profile bar 10 and in the upper panel 18, f or the rest they being entirely similar to those already described.

The couplings 30 present a substantially flat elongate body 31 from which there symmetrically extend, both lowerly and upperly, pairs of elastic appendices 33 provided with facilitated-engagement teeth 34 to engage said seats 31. Once engaged in the seats, these couplings are incorporated into the foamed insulating material injected into the compartments of the framework, hence rendering the connection between the different modular parts very stable.

Instead of using a channel 124 (figures 8 and 9) connected to the rear side of the U-shaped module 16, it is possible to use an internal air duct 130 as shown in figures 16 and 17. The duct 130 conveys the refrigerated air to the cavities and drives air inside each cavity. Moreover the duct 130 is a device that integrates all the needed function inside each cavity, i.e. to convey and drive air into the cavity, to generate light inside the cavity, and to sense one or more physical entity inside the cavity (e.g. temperature, humidity, odor, etc.). The duct 130 is provided with a main channel 130a and with an auxiliary side channel 130b. The main channel 130a is connected to a seat 132 of the bottom panel 41 and to a seat (not shown) of the top panel. The seat 132 is then connected (on its lower side) to the base module 2 where refrigerated air is driven to such seat.

In the auxiliary side channel 130b there are provided wires 134 for connecting an electronic control board 136 that communicates with the base module 2 through a bus connection. The sensors (not shown) are connected to the electronic control board 136 and a connector 138 is provided in the auxiliary channel 130b for fast connection (only one of such connectors 138 is shown in figure 16). The control board 136 drives also electrical dampers or valves 140 placed in a corresponding aperture 142 of the channel 130a for adjusting the flow of cold air to the cavity.

Another function of the air duct 130 is to support a fan (not shown) associated with the aperture 142, and to support lamps 144 (for instance LED, OLED, electroluminescent polymers etc.). The use of the air duct 130 allows a very easy and fast assembly of a modular refrigerator according to the invention. Moreover the duct 130 can be used in a modular architecture since it presents standard interfaces (mechanical

and electrical) to one of the structural module of the refrigerator and hence can be differentiated among the product range to better follow customer needs. Moreover the duct 130 (and all components integrated therein) can be easily disassembled and replaced in case of failure or in case of upgrade.

Various embodiments have been described, however others can be conceived using the same inventive concept.